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(72) Inventor ERNEST HOYLAND WEBSTER

(19)

(54) WEFT STRAIGHTENING

(71) We, WIRA, a British Company Limited by Guarantee under the Companies Acts 1908 to 1917, 1948 and 1967, of Headingly Lane, Leeds LS6 1BW, Yorkshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to woven materials, which may be of yarns of fibres and/or filaments, or of wire, which have weft strands and warp strands. Hereinafter and in the appended claims such materials will be referred to as "woven fabrics", and their weft and warp strands as "weft threads" and "warp threads", in the interests of simplicity and clarity. The invention also relates to a method of an apparatus for and a machine for use in detecting distortion of weft threads on the one hand and on the other hand for returning distorted weft threads of the woven fabrics to or towards predetermined positions.

As a fabric is being woven, the weft threads are inserted desirably so as to lie in certain positions, referred to hereinafter and in the appended claims as "predetermined positions", in which the wefts lie in planes at right angles to the direction which fabric is being produced, referred to hereinafter as "the length direction of the fabric".

During the weaving of a fabric and/or during the subsequent processing of the woven fabric, often the fabric is subjected to tensions, sometimes uneven, which result in the weft threads, or some of them, becoming distorted from the predetermined positions, and it is desirable that such distortion should be removed or reduced, or at least detected, before the fabric is sold.

When the weft threads are distorted, it is usual for the weft threads to be distorted in the same manner, i.e. they remain essentially parallel althougn not necessarily straight, and in the present invention use is made of this in determining the amount of distortion in any particular length of the fabric.

The present invention is based, for the detecting, correction or reducing of distortion of wefts in a woven fabric, on passing the fabric in its length direction at open width through a unit comprising at least two pick (weft) counting devices which are mounted close to the fabric at spaced locations in a plane at right angles to the direction of movement of the fabric.

If the weft threads are distorted only by having become inclined from the predetermined positions, and if the counters begin counting from the same weft thread or pick, after an interval of time one counter will have counted more picks than the other, the difference in the number of picks being a measure of the distortion of the weft threads from the predetermined positions. Information regarding this difference can either be stored or recorded or, wherein the distortion is to be corrected or reduced, fed to a weft straightening device so that it can impart the necessary correction to the structure of the fabric.

More complicated fabric distortions, such as bowed weft, would require more than two pick-counters for their determination and ultimate correction.

In practice, the distortion may be present in the very first pick of the fabric and even among the weft threads which are usually inserted in weaving as a "heading" before the fabric proper is woven.

According to one aspect of the present invention there is provided a length of woven fabric of which one of the weft threads at each end is or is rendered sufficiently different from the other weft threads in a particular characteristic or adaptation as to be detectable by a sensing device sensitive to such characteristic or adaptation.

By such means, where there is a distortion of weft threads from the predetermined positions, a starting position

for pick counters can readily be provided by the said one weft thread.

The said one weft at each end of the fabric preferably is more light reflective than the other wefts. In one case the said weft at each end is a Lurex (Registered Trade Mark) metallic yarn.

Also, according to the present invention there is provided a method of detecting the distortion of weft threads in a length of woven fabric of which one of the weft threads at one end is or is rendered sufficiently different from other weft threads at that end in a particular characteristic or adaptation as to be detectable by a sensing device sensitive to such characteristic or adaptation for the purposes on the one hand of recording such distortion or on the other hand of returning such distorted weft threads to or towards their predetermined positions wherein the woven fabric and at least two spaced sensing means are moved relative to one another in the length direction of the fabric, said sensing means having sensing devices positioned to sense the fabric picks at locations spaced transverse to the length direction of the fabric, and wherein each of the sensing means senses the said one weft thread at said one end of the fabric by sensing the particular characteristic or adaptation thereof, and initiates an associated pick counting device which counts the picks which pass the associated sensing device, and pick counts of the pick counting devices, or signals representative thereof, after a predetermined time or amount of said relative movement are compared to give a signal dependent upon the weft distortion which can be used for recording purposes or for controlling a machine which acts upon the fabric to return the wefts to or towards the predetermined positions.

Preferably, the sensing means are stationary and the fabric is moved to effect said relative movement.

Preferably, each sensing device includes a photosensitive means, and the said weft thread at one end of the fabric is light reflective. The said weft thread is preferably a Lurex (Registered Trade Mark) metallic yarn.

The photosensitive means, which may be a photoelectric cell, of each sensing device may also provide a pulse for the pick counter each time light from a source passes between a pair of adjacent weft threads in the fabric. The light to initiate the or each pick counting device may be supplied by a reference source and reflected to said photosensitive means by said light reflective weft yarn.

Further according to the invention, in another aspect, there is provided a method of detecting the distortion of weft threads in a length of woven fabric of the type aforesaid for the purpose on the one hand of recording such distortion or on the other hand of returning such distorted weft threads to or towards their predetermined positions wherein the woven fabric is moved in the direction of its length, comprising the steps of detecting the presence of the said one weft thread at a first detecting location, utilising such detection to initiate counting of the weft threads which pass a first counting location, which may be adjacent to or coincident with said first detecting location, detecting the presence of said weft thread at a second detecting location spaced from the first detecting location at right angles to the length direction of the fabric, utilising such detection to initiate counting of the weft threads which pass a second counting location, which is spaced from the first counting location at right angles to the length direction of the fabric and which may be adjacent to or coincident with the second detecting location, and, after a predetermined time or movement of the fabric, comparing the number of weft threads counted at the first and second counting locations, or signals representative of such counts, to obtain a signal representative of the weft distortion which can be used for recording purposes or for controlling returning of the weft threads to or towards their predetermined positions.

Preferably, the first detecting location is in alignment with the first counting location in the length direction of the fabric, or is coincident with the first detecting location, and the second detecting location is in alignment with the second counting location in the length direction of the fabric, or is coincident with the second detecting location.

Further, according to the present invention there is provided apparatus for use in detecting distortion of weft threads, or for returning distorted weft threads to or towards their predetermined positions in a fabric as aforesaid comprising a sensing means having a sensing device sensitive to said particular characteristic or adaptation of said weft thread, said sensing means being operatively connected to a pick counting device so that the pick counting device will be set to count picks of the fabric passing a location relative to the sensing device upon sensing of said weft thread by the sensing device.

Also, according to the present invention there is provided a machine for use in detecting distortion of weft threads, or for returning distorted weft threads to or towards their predetermined positions, in a fabric as aforesaid, comprising fabric feed

means whereby the fabric may be fed in its length direction through the machine, and means mounting two apparatus, each as aforesaid, positioned to sense, at locations spaced transversely of the fabric length direction, the weft picks, and to count the weft picks which pass said locations.

According to yet another aspect of the invention there is provided apparatus for use in carrying out the method of the invention comprising a pick-counting device associated with a detector capable of detecting the passage of a reference weft thread and on such passage of starting the counting mechanism of said pick counting device.

An embodiment will now be described, by way of example, with reference to the accompanying drawing in which:

Figure 1 is a diagrammatic plan view of a portion of a length of woven fabric according to the invention, the Figure also showing the positions of two sensing means;

Figure 2 is a greatly enlarged diagrammatic side elevation of the fabric shown in Figure 1; and

Figure 3 is a graph indicating output of the photocell shown in Figure 2 as normal and reference weft threads pass said photocell.

In Figure 1 a length of woven fabric 1 has warp threads 2a, 2b, 2c, etc. indicated generally by reference numeral 2, and pattern weft threads 3a, 3b, 3c, etc. indicated generally by reference numeral 3. In accordance with normal practice, the weaving of the fabric commenced with the insertion of weft threads such as 4, 5, 7, which do not form part of the pattern of fabric proper but provide a "heading" for the fabric. The weft threads 4, 5, 7, may be comprised of yarns from odd or waste packages. However one weft thread in the heading of the fabric, namely weft thread 6, is a specially selected reference thread to provide a reference for subsequent working on the fabric. The weft thread 6 in this embodiment is a Lurex (Registered Trade Mark) thread having the particular characteristic of high light reflectance, not possessed by other wefts in the fabric.

In Figure 1 the wefts of fabric are shown to be skewed, or inclined relative to the predetermined positions. That is to say, the fabric has suffered shear strain. A measure of the severity of the skew at a point along the length of the fabric is provided by the difference in the number of picks between two reference lines at or near one selvedge and the number of picks between the reference lines at or near the other selvedge when one reference line is the line of an actual pick of the fabric and the other line is spaced along the length of fabric from the said one reference line and is at right angles to the length direction of the fabric. The said other reference line is provided by the location of the two sensing devices lying on a line at right angles to the warp, whilst the line of an actual pick according to the embodiment of the invention is represented by the identifiable pick 6. In the position shown, the fabric has passed in the direction of the arrow 8 the direction in which the fabric is being produced in this example, past the sensing means 9, 10 and the counting mechanisms have been switched on by the passage of thread 6 past each individually and a counting device combined with sensing means 9 will have recorded the passage of 8 picks, whilst a similar counting device of sensing means 10 will have recorded only six. The difference in the number of picks i.e. two, is a measure of the skew or distortion of the weft threads at the position shown.

It is clear that the weft skew may vary over the whole length of the fabric, becoming more or less severe even changing direction. However, once the counting devices have been set up correctly, the monitoring of subsequent changes in the weft distortion is straightforward.

Sensing means 9, 10 include sensing devices in the form of photoelectric cells to provide a signal as shown diagrammatically in Figure 2 when the weft 6 passes. At the position shown in Figure 2, light from source 11 passes through the space between weft threads 4 and 5 and falls on photocell 12 of the sensing means 9 but at this stage the counting device is not operative. As the fabric progresses in the direction indicated by arrow 8 the light will become obscured by weft 5 and then the light will again be transmitted as weft thread 5 moves to the position occupied by weft 4 in the Figure.

Continuously, light from separate source 13 illuminates the upper face of fabric 1, but the reflectance of weft threads 4 and 5 is not such as to cause illumination of photocell 12 with light of an intensity comparable with the light transmitted through the spaces between weft thread from source 11. However, as weft thread 6 is of Lurex (Registered Trade Mark) it has a high reflectance, and as this thread passes the photocell, light from source 13, reflected by weft thread 6 produces a strong illumination of and signal from photocell 12.

Figure 3 shows diagrammatically the photocell outputs corresponding to the different positions of fabric 1. The peak of photocell output produced by the passage of weft thread 6 is used, in the example by appropriate electronic circuit, to start the counting device by which the subsequent, smaller, peaks (or troughs) and hence the

number of picks passing the sensing device can be counted.

Modifications of the example described are possible. Thus, each sensing means may include a separate sensing device working on different principles. A photocell adapted to produce a peak signal on the passage of a highly reflective thread can still however be used to start the counting device associated with the sensing device. The photocell may then be remote from the sensing device and associated counter, but will lie on the same line at right angles to the length direction of the fabric as the detector photocell located near the other selvedge.

Again, the light source 11 may itself be used to trigger the switching on of the pick-counting mechanism. In such an embodiment, light source 13 will be dispensed with and each sensing means may be provided with an auxiliary photocell, mounted on the same side of the fabric as light source 11, and electrically connected to switch on the counting device when it receives a pulse of light from light for source 11 by reflection from thread 6.

In all the embodiments referred to above, the light sources and/or photocells may be screened so that they only emit/receive light in a narrow beam, so that interference from stray light is minimised.

Further, the detection arrangement for the reference thread may itself work on a different principle, for example it could work by electrical, electro-mechanical, inductive, capacitive or magnetic means by use of a reference thread of appropriate type or adaptation of the reference thread. Such adaptations could be the connection thereto of enlargements or tapes, or the coating thereof with magnetic or electrically conductive material.

In the above examples, and primarily for simplicity, only two sensing means have been shown; there may in fact be three of four or more sensing means, each having its own counting device, depending upon the type of distortion of the weft to be remedied.

The invention is particularly advantageous when it is required to pass two or more woven fabric lengths sewn or joined end-to-end continuously through a finishing line. In this situation it will be desirable to insert or adapt a detectable weft thread at the tail end of the first fabric length and to use the signal produced on passage of said tail end weft thread to stop the sensing means and re-set them to zero so as to be ready for being started afresh by means of a detectable weft in the subsequent fabric length.

The invention can be utilized for the control of a weft straightening machine or simply for the detection of the amount of weft distortion in a woven fabric, and for recording such information, which will be useful when the fabric is being sold. Thus, some fabrics may contain an acceptable amount of weft distortion, but a user or purchaser may still require to know how much distortion is present.

WHAT WE CLAIM IS:—

1. A method of detecting the distortion of weft threads in a length of woven fabric of which one of the weft threads at one end is or is rendered sufficiently different from other weft threads at that end in a particular characteristic or adaptation as to be detectable by a sensing device sensitive to such characteristics or adaptation for the purposes on the one hand or recording such distortion or on the other hand of returning distorted weft threads to or towards their predetermined positions wherein the woven fabric and at least two spaced sensing means are moved relative to one another in the length direction of the fabric, said sensing means having sensing devices positioned to sense the fabric picks at locations spaced transverse to the length direction of the fabric, and wherein each of the sensing means senses the said one weft thread at said one end of the fabric by sensing the particular characteristic or adaptation thereof, and initiates an associated pick counting device which counts the picks which pass the associated sensing device, and pick counts of the pick counting devices, or signals representative thereof, after a predetermined time or amount of said relative movement are compared to give a signal dependent upon the weft distortion which can be used for recording purposes or for controlling a machine which acts upon the fabric to return the wefts to or towards the predetermined positions.

2. A method according to claim 1, wherein the sensing devices are located in a plane lying at right angles to the length direction of the fabric.

3. A method according to claim 1 or 2, wherein the said one of the weft threads is more light reflective than other weft threads and each sensing device includes a photo-sensitive means which receives light reflected from the said one weft thread to initiate the associated counting device.

4. A method according to claim 3, wherein each photosensitive means also provides a pulse for the associated counting device each time light from a source passes between a pair of adjacent weft threads in the fabric.

5. A method according to any one of the preceding claims, wherein the fabric has a detectable weft thread at the other end similar to said one weft thread and wherein

the sensing means similarly senses the detectable weft thread at the other end and stops the counting of picks.

6. A method according to any one of the preceding claims, wherein the sensing means are stationary and the fabric is moved.

7. A method for returning distorted weft threads of a length of woven fabric to or towards their predetermined positions, substantially as hereinbefore described.

8. Apparatus for use in detecting distortion of weft threads, or in returning distorted weft threads to or towards their predetermined positions, in a fabric of which one of the weft threads at one end is or is rendered sufficiently different from other weft threads at that end in a particular characteristic or adaptation as to be detectable by a sensing device sensitive to such characteristic or adaptation, comprising a sensing means having a sensing device sensitive to said particular characteristic adaptation of said weft thread, said sensing means also including a pick counting device operatively connected so that such device will be set to count picks of the fabric passing a location relative to the sensing device upon sensing of said one weft thread by the sensing device.

9. Apparatus according to claim 8, substantially as hereinbefore described with reference to the accompanying drawing.

10. A machine for use in detecting distortion of weft threads, or in returning distorted weft threads to or towards their predetermined positions, in a fabric of which one of the weft threads at one end is or is rendered sufficiently different from other weft threads at that end in a particular characteristic or adaptation as to be detectable by a sensing device sensitive to such characteristic or adaptation, comprising fabric feed means whereby the fabric may be fed in its length direction through the machine, and means mounting two apparatus, each as claimed in claim 8, positioned to sense, at locations spaced transversely of the fabric length direction, the weft picks, and to count the weft picks which pass said location.

11. Apparatus for use in carrying out the method according to claim 1, comprising a pick-counting device associated with a detector capable of detecting the passage of a weft thread different or rendered different from other weft threads and on such passage of starting the counting mechanism of said pick-counting device.

12. A method of detecting the distortion of weft threads in a length of woven fabric of which one of the weft threads at one end is or is rendered sufficiently different from other weft threads at that end in a particular characteristic or adaptation as to be detectable by a sensing device sensitive to such characteristic or adaptation for the purposes on the one hand of recording such distortion and on the other hand of returning distorted weft threads to or towards their predetermined positions, wherein the woven fabric is moved in the direction of its length, comprising the steps of detecting the presence of said one weft thread at a first detecting location, utilising such detection to initiate counting of the weft threads which pass a first counting location, which may be adjacent to or coincident with the said first detecting location, detecting the presence of said weft thread at a second detecting location spaced from the first detecting location at right angles to the length direction of the fabric, utilising such detection to initiate counting of the weft threads which pass a second counting location, which is spaced from the first counting location at right angles to the angle direction of the fabric and which may be adjacent to or coincident with the second detecting location, and, after a predetermined time or movement of the fabric, comparing the number of weft threads counted at the first and second counting locations, or signals representative of such counts, to obtain a signal representative of the weft distortion which can be used for recording purposes or for controlling returning of the weft threads of the fabric to or towards their predetermined positions.

13. A length of woven fabric, suitable for use with the method of claim 5 of which one of the weft threads at each end is or is rendered sufficiently different from the other weft threads in a particular characteristic or adaptation so as to be detectable by a sensing device sensitive to such characteristic or adaptation.

BAILEY, WALSH & CO.,
Chartered Patent Agents,
9 Park Place,
Leeds, LS1 2SD,
Agents for the Applicants.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

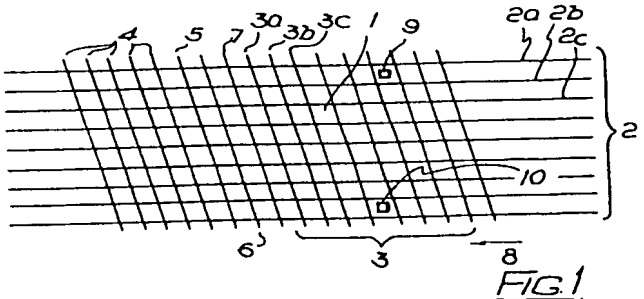

FIG.1

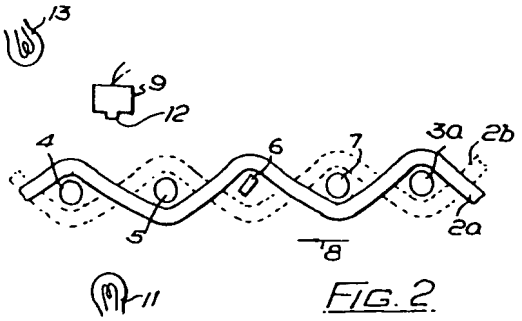

FIG. 2

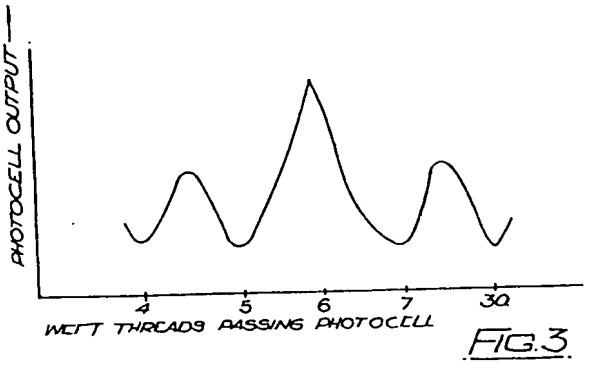

FIG.3